Citation:

Pereira MA, Swain J, Goldfine AB, Rifai N, Ludwig DS. Effects of a low-glycemic load diet on resting energy expenditure and heart disease risk factors during weight loss. JAMA 2004; 292: 2482 - 2490.

PubMed ID: 15562127

Study Design:

Randomized Controlled Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To determine whether dietary composition affects the physiological adaptations to weight loss, as assessed by REE, as well as several conventional and novel cardiovascular disease risk factors as secondary end points.

Inclusion Criteria:

Overweight or obese young adults aged 18 - 40 years, BMI at least 27, weight below 135 kg (300 lb), change in body weight of less than 10% during the past year, good general health, normal laboratory screening results (including CBC, serum electrolytes, thyroid-stimulating hormone, blood glucose, glycosylated hemoglobin, urinalysis, and liver functions - alanine aminotransferase up to twice normal limit acceptable), willing to abstain from alcohol for duration of study, able to come to research unit daily to obtain study foods.

Exclusion Criteria:

No medical conditions or medications that might affect body weight, appetite or energy expenditure, nonsmoker, not regularly engaged in heavy/vigorous physical activity, not currently following a special diet, no history of an eating disorder, no allergies or aversions to foods on the study menu, not taking dietary supplements, not pregnant during the last year, no plans to become pregnant in the next year, not lactating, not taking birth control pills.

Description of Study Protocol:

Recruitment

Participants recruited through posted flyers and newspaper advertisements in Boston metropolitan area.

Design

Randomized Parallel-Design Trial. Sequence randomly generated by computer.

Blinding used (if applicable)

Only dietary staff was aware of treatment assignment. Study personnel collecting measurements were blinded.

Intervention (if applicable)

Subjects received an energy-restricted diet, either low-glycemic load or low-fat.

Statistical Analysis

General linear models were used to test the effect of dietary treatment on change in REE and cardiovascular disease risk factors. Endpoints for baseline values were adjusted using ANCOVA. Although sex was included as a covariate in the model, treatment x sex interactions were not tested because only 9 men were enrolled. To address noncompleters in intention-to-treat models, 2 different strategies were used to impute REE change. Sample size for the study was based on differences between treatments from previous studies. 46 participants (23 per group) were estimated to provide 80% power to detect a difference between diets in REE of 125 kcal/day with alpha = 0.05.

Data Collection Summary:

Timing of Measurements

Participants were given a standard weight-maintenance diet during a 9-day run-in period and then were admitted to metabolic unit for 3 days to obtain baseline measurements. At discharge, participants began the experimental or control diets, providing 60% of predicted energy requirements. After achieving 10% body weight reduction, participants readmitted for 5 days to obtain final measurements of study end points.

Dependent Variables

- REE measured by indirect calorimetry in fasting state with participants awake and lying quietly in bed with room temperature maintained and lighting and noise at a minimum
- Body composition measured through DXA
- Fasting blood samples analyzed for glucose, insulin, lipids and C-reactive protein
- Hunger measured through visual analog scales
- Height and weight measured by calibrated balance beam scale with participants wearing light clothing, shoes removed, pockets emptied
- Physical activity level assessed using 7-Day Physical Activity Questionnaire
- Blood pressure obtained in right arm after participants seated quitely for 5 minutes - 3 readings taken with automated unit, average the last 2 readings

Independent Variables

- 7-day menu cycle for experimental low-glycemic load (1500 kcal, glycemic index of 50, glycemic load of 82, 43% carbohydrate, 27% protein, 30% fat) or low-fat control diet (1500 kcal, glycemic index of 82, glycemic load of 205, 65% carbohydrate, 17% protein, 18% fat). All foods for both inpatient and outpatient phases were prepared in metabolic kitchen and weighed to nearest 0.5 g. Diets were designed to produce 10% weight loss during 6 - 10 week period. Participants kept daily food logs to record instances of nonadherence, adverse effects, hunger levels, and exercise. Dietitians provided behavioral support and encouragement daily.

Control Variables

Description of Actual Data Sample:

Initial N: 46 subjects were randomly assigned, 23 to each group.

Attrition (final N): 39 subjects, overall retention rate 85%. 17 completed Low-Fat diet, 13 women, 4 men - 6 discontinued the intervention (4 nonadherent, 1 illness, 1 scheduling conflict). 22 completed Low Glycemic Load diet, 17 women, 5 men - 1 nonadherent. Noncompleters did not differ from completers in age or REE, but noncompleters did have higher baseline BMI.

Age: Low-fat diet: 32.6 +/- 4.3 years, Low glycemic load diet: 28.8 +/- 6.3 years

Ethnicity: Low-fat diet: 8 White, 5 Black, 3 Latino, 1 other. Low glycemic load diet: 13 White, 4 Black, 4 Latino, 1 other.

Other relevant demographics:

Anthropometrics: No significant differences between groups in baseline characteristics.

Location: Boston, Massachusetts

Summary of Results:

	Low-Fat Diet (n=17)	Low Glycemic Load Diet (n=22)	P value
Final Weight, kg	82.1 +/- 0.3	81.9 +/- 0.3	0.75
Weight Loss, kg	9.5 +/- 0.3	9.6 +/- 0.3	0.75
Weight Loss, %	10.5 +/- 0.3	10.5 +/- 0.3	0.93
Final Lean Mass, kg	50.1 +/- 0.3	50.5 +/- 0.3	0.45
Final Fat Mass, kg	28.8 +/- 0.6	28.7 +/- 0.5	0.85

Other Findings

By study design, all participants completing the protocol lost 10% of body weight. The mean time between baseline and post-weight loss clinic visits was 69.4 +/- 3.8 days for low-fat and 65.2 +/- 3.3 days for low-glycemic load groups. Individual rates of weight loss were nonsignificantly greater in the low-glycemic load group (1.09 +/- 0.05 vs 0.99 +/- 0.05 kg/week, P = 0.19).

REE decreased less with the low-glycemic load diet than with the low-fat diet, expressed in absolute terms (96 +/- 24 vs 176 +/- 27 kcal/day, P = 0.04) or as a proportion (5.9% +/- 1.5% vs 10.6% +/- 1.7%, P = 0.05).

Participants receiving the low-glycemic load diet reported less hunger than those receiving the low-fat diet (P = 0.04).

Insulin resistance (P = 0.01), serum triglycerides (P = 0.01), C-reactive protein (P = 0.03) and

blood pressure (P = 0.07 for both systolic and diastolic) improved more with the low-glycemic load diet.

Changes in body composition (fat and lean mass) in both groups were very similar (P = 0.85 and P = 0.45, respectively).

Author Conclusion:

In conclusion, we found that the physiological adaptations to a weight-reducing diet thought to antagonize ongoing weight loss, involving energy expenditure and hunger, can be modified by dietary composition. In addition, the low-glycemic load diet had beneficial effects on several obesity-related risk factors compared with a low-fat diet that was consistent with current nutritional guidelines. Incorporation of glycemic load principles into current dietary guidelines may aid in the treatment of obesity and prevention of cardiovascular disease and diabetes mellitus, a possibility that warrants evaluation in long-term randomized controlled trials.

Reviewer Comments:

85% retention rate - high considering the strictness of dietary intervention at 60% of energy needs. All food prepared in metabolic kitchen.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes

2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes

5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	Yes
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	Yes
6.6.	Were extra or unplanned treatments described?	Yes
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes

	7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	Yes
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes